1911 #2

LACUSTRINE CLAY

Of the

EDMONTON REGION

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Submitted by

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Prefatory Note.

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The following pages contain the result of some one hundred and twenty-five hours of laboratory work spent in making physical and chemical examination of the typical lacustrine clay of the Edmonton region, and tests of local clay of earlier geological age.

Economic Aspect

The commercial importance of clay may be readily understood from the value of the products. According to the Canada Year Book compiled by the Dominion Government Statistics Department, the total value of clay products in the Dominion, for 1906, including brick, tile and pottery, amounted to $4,774,305. The wages paid to the 6154 wage-earners employed amounted to $1,803,287. A noteworthy increase in the value of clay products is evidenced by the fact that for 1909 the value of bricks alone was $4,200,000.

The value of clay products in the United States for 1907 was $158,942,369.

Lacustrine Clay.

The greater portion of the surface of the rather well-defined plain around Edmonton consists of old lake deposits, silt and clay. These deposits characterize nearly the whole of the old lake bottom followed by the Calgary and Edmonton Railway. North of Edmonton the lake bottom exposure extends west over the Stony Plain district, east to the glacial deposits of the Beaver Hills, and north for some forty or fifty miles to the sand-ridges characteristic of the watershed between the Saskatchewan and Athabasca Rivers. Northwest the lacustrine surface is distinct until it becomes obscured by morainic material near Onoway on the main line of the C.N.R.

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evidence of the Kewatin ice-sheet, with possible evidence of a previous Cordilleran glaciation.

The retreat of the final ice-sheet with formation of glacial lakes probably accounts for these extensive deposits of lacustrine clay of Pleistocene age.

The Saskatchewan and its tributaries by erosion of the boulder-clay contained in the banks, carry down great quantities of fine material much of which goes to form clay deposits of the flood-plain variety. These deposits partake of the yellow color of the boulder-clay.

An important local deposit of compact clay, decidedly different in character from the widespread lacustrine clay,occurs within the limits of the City of Strathcona. This deposit underlies several feet of boulder-clay and would appear to be either interglacial or the product of the possible Cordilleran glaciation. Contrasted with the typical clay it presents the following features :

Dark grey in color ; very compact; fracture rough ; brownish-grey on strong ignition; loss on

difficulties that beset the construction of roads without gravel or stone.

It should be stated that at various points in the region in which the lacustrine deposits occur, the presence of large amounts of soluble alkaline salts render the clay unfit for making face brick. The occurrence of objectionable white efflorescence would be certain. It is very doubtful whether thorough weathering would remove enough of this "alkali" by leaching, to avoid the development of efflorescence. The use of coal for "burning" is liable to lead to formation of sulphates which will produce the white efflorescence known as "wall-white"

Physical Analysis.

The sample used was taken from a deposit near Fort Saskatchewan. It is yellowish grey in color, has an even, angular fracture and readily crushes to an almost impalpable powder.

Experiments were made to determine the relative fineness of the clay. A sample of 100 grams was taken. This was boiled with water and treated to cause disintegration. After repeated agitations with relatively large volumes of water, the following separation was made :

Precipitated in 1 minute - - - -	1.10
" " 3 minutes - - - -	3.96
" " 10 " - - -	7.20
" " 60 " - - - -	74.70
in suspension after 60 minutes - - -	13.58
	100.54

Microscopic examination revealed the fact that the sample had been separated into fairly defined "aggregates" which were strongly resistant to the attempts made to disintegrate the sample.

Less than one per cent consisted of sand granules varying from .0332 mm. to .1328 mm. in diameter. The remainder of the sample consisted of particles of an average diameter of .0010 mm., with .0006mm. as a minimum and .0027 mm. as a maximum. The extreme fineness and uniformity of the sample are strikingly characteristic.

This clay exhibits a good degree of plasticity. While no simple theory seems adequate to explain the clause of plasticity in clays, the remarkable fineness of the clay under discussion may be assigned very properly as one of the causes of its great plasticity.

On ignition air-dried samples were found to lose 9.55 per cent. Of this 3.50 per cent was moisture capable of being expelled by heating for several hours to a point slightly above the boiling point of water.

The ignited sample became reddish-brown as might have been expected from the presence of nearly six per cent. of ferric oxide.

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less than one per cent consisted of sand granules varying from .0272 mm. to .1238 mm. in diameter. The remainder of the sample consisted of particles of an average diameter of .0010 mm., with .0006 mm. as a minimum and .0027 mm. as a maximum. The extreme fineness and uniformity of the sample are strikingly characteristic.

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On ignition air-dried samples were found to lose 9.05 per cent. Of this 7.36 per cent was moisture capable of being expelled by heating the material to a point slightly above the boiling point of water.

The ignited sample became reddish-brown as might have been expected from the presence of nearly six per cent. of ferric oxide.

The fineness of the clay would make it possible

to use the ignited material as a pigment. Rubbed up with oil it presents a sienna-like appearance.

The weight of water absorbed by 100 grams of clay was found to be 63.80 grams. With the 3.50 per cent. im an air-dried sample, the tatal absorptive power of 100 grams of moisture-free clay is thus 67.30 grams. Or the amount of water in a saturated sample is slightly over 40 per cent.

Whem the saturated mass was allowed to air-dry, it became hard enough to withstand very rough handling.

Chemical Analysis.

Formed largely of material eroded from the characteristic Laurentian rocks, the clay exhibits a composition consistent with such origin.

Undoubtedly a large portion of the silicon is present as the dioxide derived from the quartz of gneissoid rocks.

The aluminum is present in almost the same proportion as in orthoclase.

Magnesium is traceable to such minerals as muscovite, hornblende and pyroxene.

Fragments of these minerals have been detected in the Leda clays of Canada - of one of which an analysis is appended.

For the sake of comparison there are also appended analyses of a number of United States clays.

Analysis of Edmonton Lacustrine Clay.

Silica - - - - - - - - -	59.60
Alumina - - - - - - - -	17.96
Ferric Oxide - - - -	5.94
Magnesia - - - - - - -	1.86
Lime - - - - - - - - - -	2.60
Moisture - - - - - - - -	3.50
(Additional) Loss on ignition -	6.05

A comparison of these results with various analyses shows this clay to resemble chemically good brick clays.

The following figures are given by Willet G. Miller as the percentage composition of an ordinary brick-clay.

Silica - - - - - - - -	-59.96
Alumina - - - - - - - -	-19.58
Ferric Oxide - - - - -	5.86
Lime - - - - - - - - -	2.62
Magnesia - - - - - - -	2.30
Potash - - - - - - - -	2.57
Soda - - - - - - - - -	2.48
Sulphur trioxide - - -	.23
Water, Carbon dioxide, &c	-5.00

The close resemblance is apparent.

It should be noted that chemical analysis alone does not give a true estimate of the economic value of a clay. It is necessary to take into consideration the physical side of the question.

Fire-Clays.

The term fire-clay is loosely employed to designate clay of high fusion-point, though sometimes wrongly applied to material occurring in situations similar to those in which true fire-clay is found. Fire-clay is often found underlying coal-beds, though no thoroughly satisfactory explanation of such occurrence has been offered. Frequently the clays and shales underlying coal-seams are non-refractory. Extensive beds of refractory clay are found in the Atlantic and Gulf coastal plains non-associated with coal-beds.

A good fire-clay must be highly refractory, hence its composition should show low percentages of such fluxing materials as ferric oxide, lime, magnesia and alkalies. The late Prof. E.J.Chapman was accustomed to condemn a sample if it became tawny under ignition. Certain fire-clays seem to have excellent heat-resisting power, though iron content is appreciable.

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The following are analyses taken from Reports of the U.S. Geol. Survey, and Missouri Geol. Survey respectively:

	New Jersey No.1 Fire-Clay.	St.Louis Fire-Clay
Silica	51.56	59.36
Alumina	33.13	23.26
Ferric Oxide	.78	3.06
Lime	tr.	.65
Magnesia	tr.	.42
Potash	tr.	.63 (Potash and Soda)
Soda	tr.	
Titanic Acid	1.91	1.01
Water	12.50 (Water and Moisture)	10.20
Moisture		2.74

The high value of fire-clay makes it desirable that some systematic effort should be made to discover deposits in Alberta. They are widely distributed in the United States both geologically and geographically.

Analysis of a St.Lawrence Pleistocene (Leda) Clay.

Silica - - - - - - -	52.95
Alumina & Ferric Oxide	27.30
Lime - - - - - - - -	-5.32
Magnesia - - - - -	2.62
Potash - - - - - -	1.26
Soda - - - - - - -	2.06
Phosphoric Acid -	.74
Carbonic Acid - - -	3.25
Water - - - - - - -	5.50

(Geol. Survey of Canada, 1863).

Wisconsin Pleistocene Clay.

Used for common brick. Considered of little value for any other purpose.

Silica - - - - -	48.39
Alumina - - - - -	12.50
Ferric Oxide - -	5.40
Lime - - - - - - --	10.88
Magnesia - - - --	4.82
Potash - - - - - -	3.90
Soda - - - - - - -	.68
Loss on ignition	13.02
Titanic Acid - -	.43

North Dakota Pleistocene Clay.

This is a typical calcareous clay regarded as of value for little else than common brick.

Silica - - - - -	51.27
Alumina - - - -	9.33
Ferric Oxide - -	3.52
Lime - - - - - -	11.15
Magnesia - - -	2.31
Soda - - - - -	2.08
Potash - - - - -	.50

Sewer- Pipe Clay, Red Wing, Minnesota.

Much of the sewer- pipe used in Alberta is made from this.

Silica - - - -	69.84
Alumina - - - -	23.07
Ferric Oxide - -	.48
Lime - - - - - -	.11
Magnesia - - - -	.14
Potash) Soda) - - - -	trace
Water - - - - - -	6.35

Sewer-Pipe Clay, Canton, O.

Silica - - - - - --	57.10
Alumina - - - - -	21.29
Ferric Oxide - -	7.31
Lime - - - - - - -	.29
Magnesia - - - - -	1.53
Potash - - - - -	3.44
Soda - - - - - - -	.61
Water - - - - - - -	7.30